

Dracoderidae, a New Family of the Cyclorhagid Kinorhyncha from the Inland Sea of Japan¹

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ABSTRACT—A new family, Dracoderidae, is erected to include *Dracoderes abei*, n. sp., n. gen., described from subtidal muddy sediment of the Inland Sea of Japan at Mukaishima Island. This species is distinguished from all other known kinorhynch species by the presence of alternating laterally displaced dorsal spines on segments 4–10 and a middorsal spine on segment 11, and on segment 12 of males. In addition, this species has a unique series of five 3-element oral styles alternating with four single-element oral styles. No midterminal spine or lateral terminal accessory spines are present in either sex. The male has three penile spines as in *Echinoderes*; one is exceptionally long and easily mistaken for a lateral terminal accessory spine, the other two penile spines are short, one with cuticular banding.

INTRODUCTION

The first report of a member of the Phylum Kinorhyncha from Japan was *Echinoderes masudai* Abe, 1930 from Gogoshima Island near Hiroshima. In the 60 years since Abe's paper [1] was published, Tokioka [2] reported two *Echinoderes* species and Sudzuki [3–5] found three kinorhynch species representing two genera from various localities of the Japanese coastal waters.

The description of *Echinoderes masudai* by Abe [1] was too poor that we considered its precise redescription is necessary. In April 1986, we thus carried out bottom dredgings in the area close to the Mukaishima Marine Biological Station of the Hiroshima University to collect other specimens of *E. masudai*. The area was selected because it appeared to be a relatively undisturbed habitat reasonably close to the type locality of the species.

This paper is to describe a new kinorhynch species found from the dredge samples. The species was easily classified as a member of the

order Cyclorhagida. But on the basis of its characteristics in dorsal spines, oral styles and penile spines, it was considered necessary to erect a new genus and family to address the new species.

MATERIALS AND METHODS

The specimens described in this paper were collected by the authors from subtidal (3 m) sandy mud found in the Mukaishima yacht harbor, southwest of the Mukaishima Marine Biological Station, 17 April 1986. Collections were made with a Higgins Meiobenthic Dredge [6].

Kinorhynchs were removed from the sediment by the bubbling technique [6]. Laboratory procedures followed a standard protocol [7]. Specimens were transferred by an Irwin Loop from a 10% formalin fixative to a 2% solution of glycerin in deionized water, the water was allowed to evaporate, leaving the specimens in glycerin from which they were transferred to a small drop of Hoyer's-125 mounting medium on a double-coverglass Higgins-Shirayama slide mount [6]. Specimens were observed by differential interference and phase contrast optics, measurements are given in micrometers (μm), standard kinorhynch abbreviations

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are used.

Specimens mentioned in this paper are deposited in the National Museum of Natural History, Smithsonian Institution, indicated by USNM catalog numbers and by the senior author's reference numbers (RH).

DESCRIPTION

Order Cyclorhagida Zelinka, 1896

Suborder Cyclorhagae Zelinka, 1896

Dracoderidae, n. fam.

Diagnosis.—Segment 2 consisting of 14 placids, midventral placid widest, others of different widths. Segment 3 consisting of complete ring of cuticle. Segments 4–13 consisting of two sternal plates articulating midventrally with each other and laterally with single rounded tergal plate. Midterminal and lateral terminal accessory spines absent in adult (juveniles unknown). Dorsal spines on segments 4–10 alternatingly offset lateral to midline, middorsal spine present on segment 11 of both male and female, and on segment 12 of male only. Cuspidate lateral spines absent. Midventral and four other oral styles well cuticularized, with three elements (two-jointed); remaining (alternate) four oral styles with thin cuticle, one element (unsegmented).

Type genus.—*Dracoderes* n. gen.

Included genera.—One, *Dracoderes*, n. gen.

Dracoderes, n. gen.

Diagnosis.—Identical with family diagnosis.

Type species.—*Dracoderes abei*, n. sp.

Etymology.—The genus name is derived from the Greek (*drakon*) dragon plus (*deres*) neck. The gender of the genus is masculine.

Dracoderes abei, n. sp.

(Figs. 1–5)

Diagnosis.—Identical with genus diagnosis.

Etymology.—This species is named in honor of Yoshio Abe, the first Japanese scientist to study a kinorhynch.

Type Material.—Holotype, adult female, RH 2086.1, USNM 235446, col. R. Higgins and Y.

Shirayama, 17 April 1986, sandy mud, 3 m depth, Mukaishima yacht harbor (southwest of Mukaishima Marine Biological Station), 34° 21.5'N., 133° 13.0'E. Allotype, adult male, RH 2079.1, USNM 235447, 10 m depth, other data same as for holotype.

Description.—Holotype, adult female (Figs. 1, 5a–c), trunk length 276 μm ; MSW-6 (*maximum sternal width at segment 6*) 76 μm , 28% of trunk length; SW (*standard width at segment 12*) 66 μm , 24% of trunk length.

Segment 2 (neck) apparently consisting of 14 placids of varying width. Length of placids not measurable because of withdrawn head. Midventral placid (placid 1) ca. 16 μm wide, adjacent placids (placids 2) ca. 8 μm wide, placids 3 ca. 8 μm wide, placids 4 and 5 (both lateral and distorted by compression) not measurable, placids 6 ca. 5 μm , placids 7 ca. 8 μm , middorsal placid (placid 8) ca. 5 μm .

Segment 3 (first trunk segment) a ring of cuticle 31 μm long (measured laterally in optical section), with prominent pachycyclus. Subdorsal, round to oval cuticular scars occur slightly posterior to midlength of segment with presumptive sensory spots slightly more lateral and nearer anterior margin of ventral surface. Perforation sites (of cuticular hairs) few and scattered. Cuticular pores (also in male, Fig. 5e, PO), possibly complex sensory spots, present on either side of ventral midline. Posterior margin of cuticle consisting of pectinate fringe as in all succeeding segments.

Segment 4 and all succeeding segments consisting of single, oval-arched dorsal (tergal) plate with each lateroventral margin articulating with lateral margin of one of two single lateroventral (sternal) plates to form distinct tergal-sternal articulation zone; two lateroventral plates articulating midventrally. Pachycyclus of tergal and sternal plates well developed. Length of segment 4, 32 μm . Single dorsal spine, 40 μm long, located lateral to dorsal midline; area of attachment of spine with distinctive anterolateral extensions as in all succeeding dorsal spines. Moderately spaced perforation sites appearing to be in three poorly organized horizontal rows on tergal plate, and in two poorly organized horizontal rows on each sternal plate. Moderately robust, lateral spine, 16 μm long, present

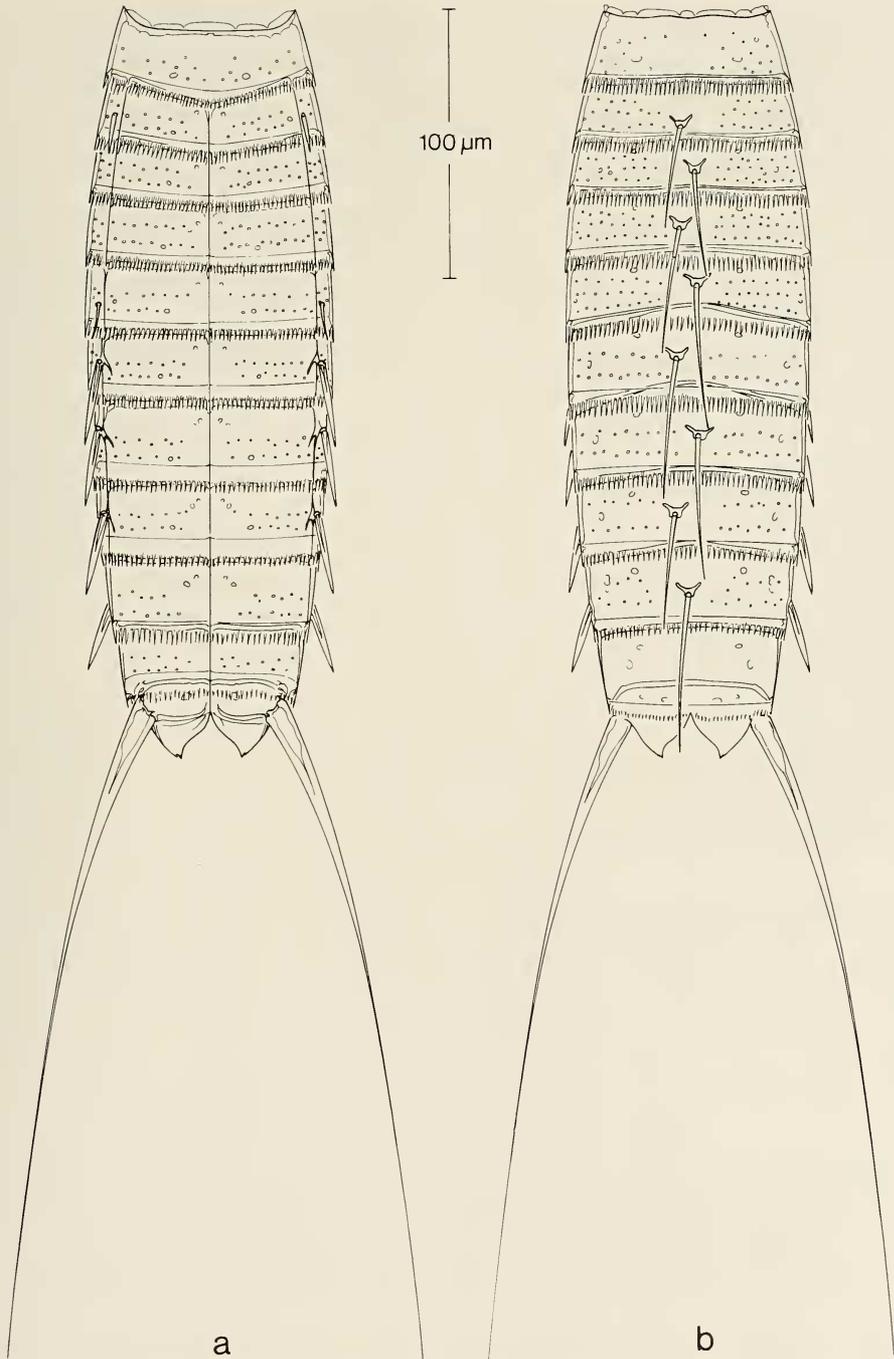


FIG. 1. *Dracoderes abei* n. gen., n. sp., holotypic female, USNM 235446, neck and trunk segments; a, ventral view; b, dorsal view.

about midway near lateral margin of tergal plate. Sensory spot present slightly mesial to the midline

and near posterior margin of each sternal plate, second sensory spot or possibly a cuticular pore

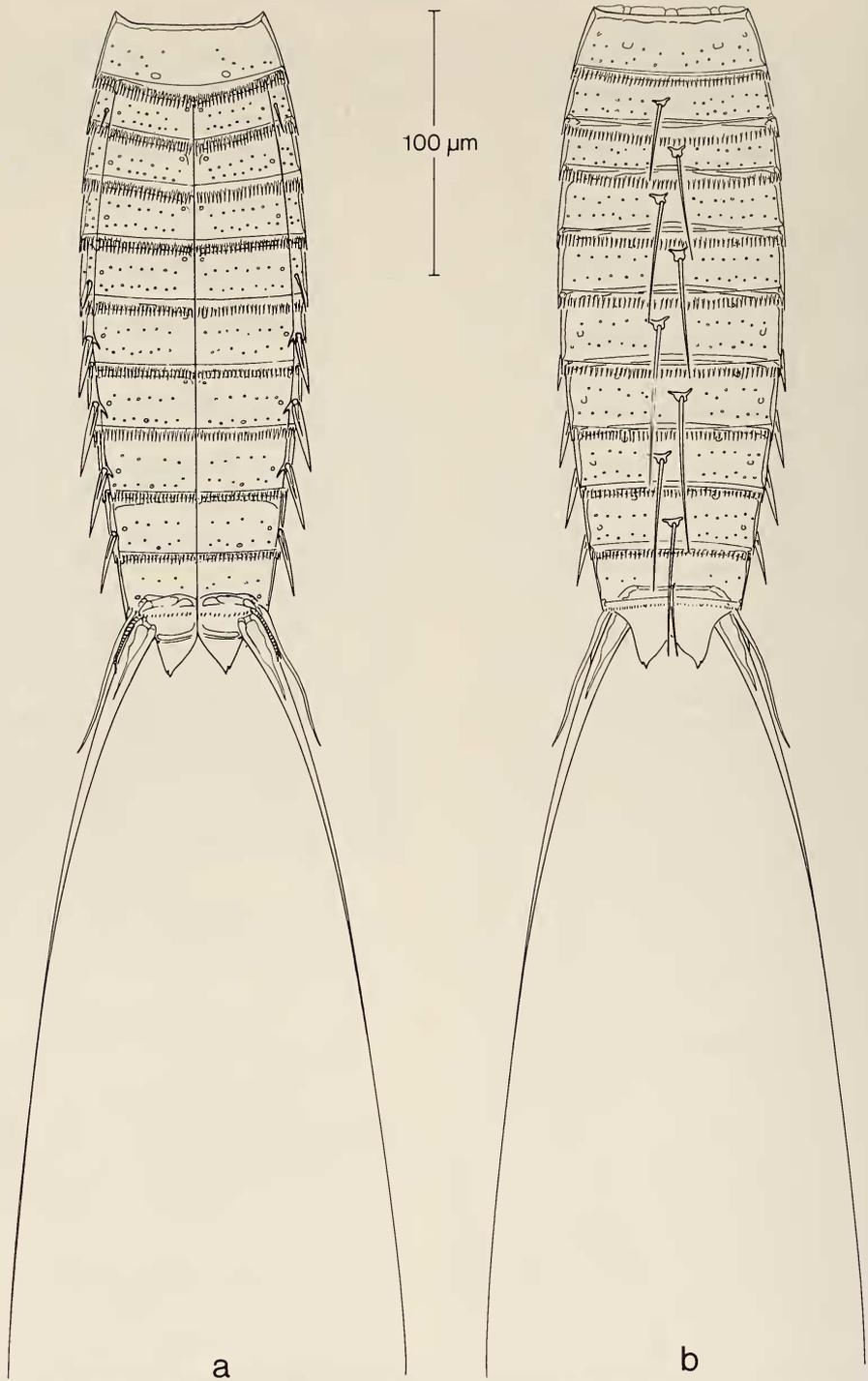


FIG. 2. *Dracoderes abei* n. gen., n. sp., allotypic male, USNM 235447, neck and trunk segments; a, ventral view; b, dorsal view.

located about midlength near the lateral margins. Presumptive cuticular pore located near anterome-

sial margin of each sternal plate; pore canal extending posteriorly from pore. Sternal muscle

scars, poorly defined in anterior segments, present posterolaterally to presumptive cuticular pores.

Segment 5, 32 μm long, with prominent dorsal spine, 44 μm long, situated laterally to middorsal line, alternate to position of dorsal spine on segment 4. No lateral spines present. Perforation sites appear similar to pattern on segment 4. Cuticular scar, possibly a pore, situated subdorsally, usually hidden by pectinate fringe of preceding segment; other cuticular structures such as sensory spots similar to those of preceding segment. Presumed muscle scars present near midlateral margins of tergal plate.

Segment 6, 30 μm long. Maximum sternal width (a measurement of the anterior margin of the widest pair of sternal plates), 76 μm , 28% of trunk length, occurring at segment 6. Prominent dorsal spine, 48 μm long, situated laterally to middorsal line, alternate to position of dorsal spine on preceding segment. No lateral spines present. Other

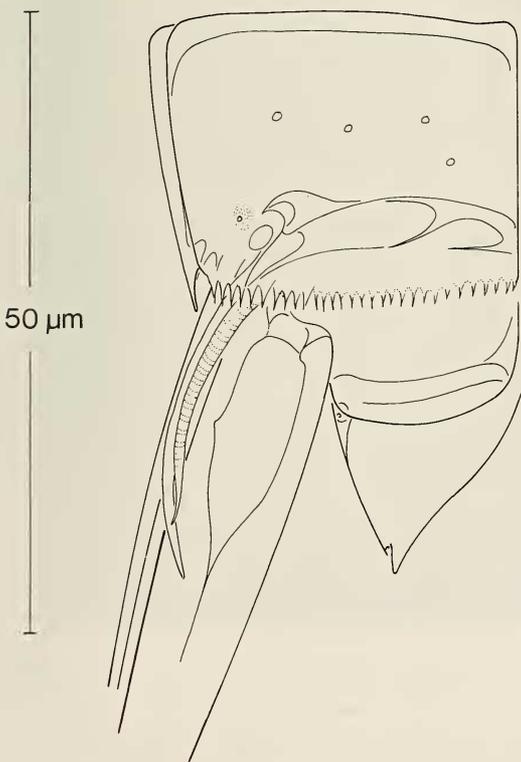


FIG. 3. *Dracoderes abei* n. gen., n. sp., allotypic male, USNM 235447, right half, segment 12 and 13, ventral view.

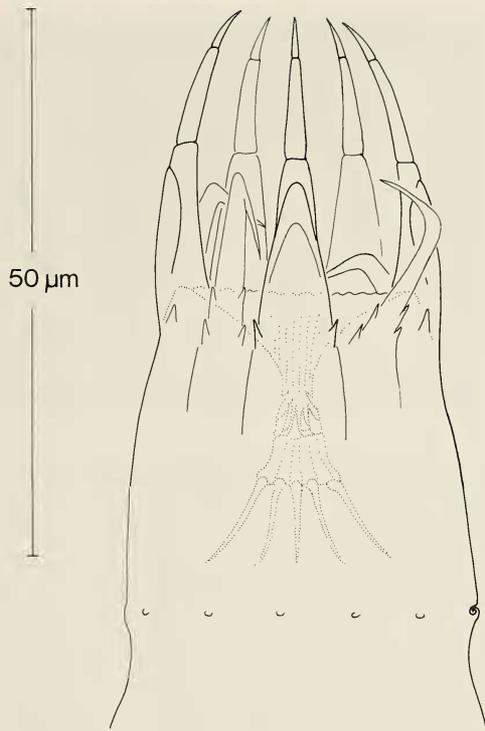


FIG. 4. *Dracoderes abei* n. gen., n. sp., allotypic male, USNM 235447, mouth cone, ventral view.

cuticular structures similar to those described for segment 5.

Segment 7, 34 μm long, with prominent dorsal spine 52 μm long, situated laterally to middorsal line, alternate to position of dorsal spine on preceding segment. Lateral spine (Fig. 5a, L7), 15 μm long, narrowly acicular, probably an adhesive tube, present adjacent to lateral margins of tergal plate. Other cuticular structures similar to those described for segment 6.

Segment 8, 34 μm long, with prominent dorsal spine, alternately situated as in previous segments. Perforation sites appear organized in only two rows. Robust lateral spine (Fig. 5a, L8), 32 μm long, present adjacent to lateral margins of tergal plate. Unlike other kinorhynchs, cuticle of tergal plate appears diverted around base of spine, lateral margin of adjacent sternal plate near base of lateral spine with ca. 5- μm incision (Fig. 5a, SI) extending posteromesially; lateral spine thus appearing to be positioned between the tergal and sternal plates rather than on lateral margins of

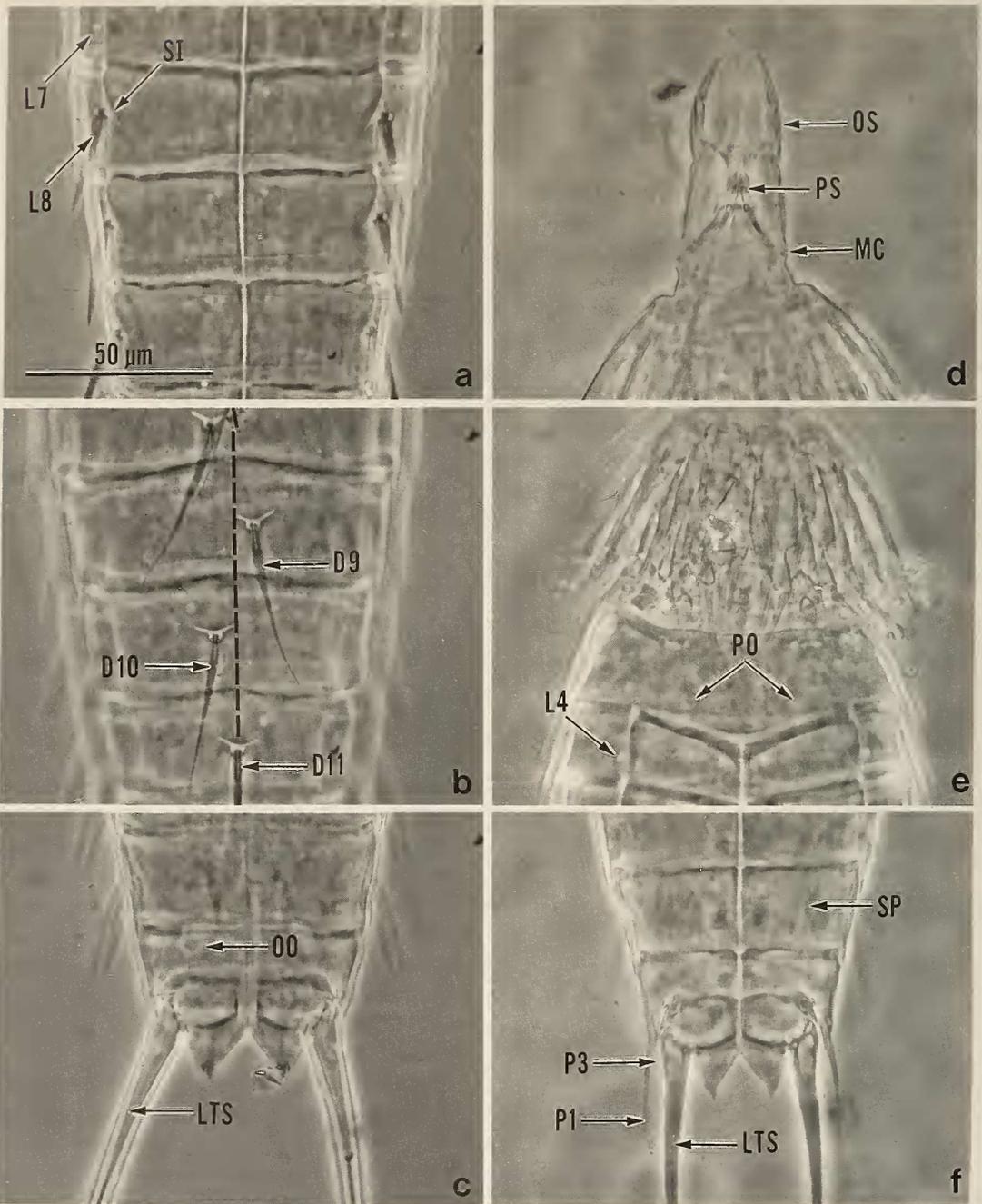


FIG. 5. *Dracoderes abei* n. gen., n. sp.; a, holotypic female, USNM 235446, segments 7-9, ventral view; b, same, segments 8-11, dorsal view (broken line indicates middorsal plane); c, same, segments 11-13, ventral view; d, allotypic male, USNM 235447, mouth cone, optical section; e, same, segments 1-4 (head, neck, and first two trunk segments), ventral view; f, same, segments 11-13, ventral view. Phase contrast photomicrographs all to scale shown in a. D9, D10, D11, dorsal spines; LTS, lateral terminal spine; L4, L7, L8, lateral spines; MC, mouth cone; OO, oocyte; OS, oral styles; PO, pore; PS, pharyngeal styles; P1, P3, penile spines; SI, segment incision (on segment 8); SP, spermatozoa.

tergal plate (Fig. 1a). Other cuticular structures similar to those described for segment 7.

Segment 9, 34 μm long, has prominent dorsal spine (Fig. 5b, D9), 52 μm long, alternately situated as in previous segments, and lateral spine, 30 μm long, similar to that of preceding segment; segment otherwise similar to segment 8.

Segment 10, 32 μm long, with prominent dorsal spine (Fig. 5b, D10), 44 μm long alternately situated as in previous segments, lateral spine, 30 μm long, similar to that of preceding segment; segment otherwise similar to segment 9 but with fewer perforation sites.

Segment 11, 33 μm long, with middorsal spine (Fig. 5b, D11), 54 μm long and lateral spine, 28 μm long, similar to that of the preceding segment but without cuticular incision at the lateral margins of sternal plates. Pachycyclus appearing narrower than in preceding segments and with fewer perforation sites.

Segment 12, 33 μm long, lacking both dorsal and lateral spines. Standard width (a measurement across the anterior margin of segment 12), 66 μm , 24% of trunk length. Segment otherwise similar to preceding segment but with fewer perforation sites, no apparent muscle scars, and less developed pachycyclus structure.

Segment 13, 30 μm long, without dorsal spine. Lateral terminal spines (Fig. 5c, LTS), 250 μm long, nearly equal to trunk length (LTS/TL 91%), extending posterolaterally from anterolateral margins of segment. Perforation sites not apparent; large oval muscle scar located near anteromesial margin, usually covered by pectinate fringe of preceding segment; other cuticular scars not apparent. Posterior margin of sternal plates rounded, extremely thin cuticle preventing accurate determination of limits of plates. Tergal plate bifurcating into distinctively shaped tergal extensions, rounded laterally, pointed distally, apparent sensory spot near the lateral margin adjacent to apex. Mesial border of tergal extensions proceeding directly anterior from apex before curving mesially to junction at ventral midline.

Allotype, adult male (Figs. 2-4, 5d-f), trunk length 248 μm ; MSW-8 76 μm , 31% of the trunk length; SW 54 μm , 22% of the trunk length. Lateral terminal spines 290 μm long, 117% of the

trunk length.

The lateral and dorsal spines of the male are similar to those of the female. The major differences between the female and male include an additional middorsal spine, 28 μm long, on segment 12; 3 penile spines at anterolateral margin of each sternal plate of segment 13; relatively longer (LTS/TL 117%) lateral terminal spines; and slightly different dorsoventral trunk outline which reaches a maximum sternal width more posteriorly (MSW-8, MSW/TL 31%) than in the female and tapers to a relatively narrower standard width (SW/TL 22%). The largest and most prominent penile spine (Fig. 5f, P1) is 60 μm long and superficially resembles the lateral terminal accessory spine present in females of the family Echinoderidae. A second penile spine with an extremely thin cuticle is ca. 26 μm long. The third penile spine (Fig. 5f, P3), ca. 20 μm long, has an equally thin cuticle with slightly thicker bands (Fig. 3).

The head (segment 1) of the allotypic male (Fig. 5d, e) was everted and the mouth cone (Figs. 4, 5d) extended. The scolid numbers and arrangement are not easily determined, but the clearly extended mouth cone exhibited some characteristics unique to the phylum. Nine oral styles (Fig. 5d, OS), located on all but the middorsal (sector 1) B-radii [8], surround the mouth cone. The mid-ventral oral style (B-6) and all other even-sector (B-2, B-4, B-8, and B-10) oral styles consist of three elements: a pointed distal element ca. 5 μm long, a median element ca. 11 μm , and a basal element ca. 18 μm long. A cuticular thickening appears on the external surface of each basal element; short, single, small lateral spines are present on either side of its attachment to the mouth cone. The four odd-sector oral styles (B-3, B-5, B-7, and B-9) have a extremely thin cuticle and consist of a single, unsegmented element with two small lateral spines on either side of the base.

DISCUSSION

Although superficially *Dracoderes abei* appears to be a member of the genus *Echinoderes*, close examination reveals several characters which requires the erection of a new genus which could be assigned to either the family Centroderidae or the

family Echinoderidae. At the same time a suite of unique characters requires that a new family be established for *Dracoderes*.

On the basis of the complete, undivided ring of cuticle which comprises the segment 3 (the first trunk segment) and the division of the remaining segments into a tergal and two sternal plates, *Dracoderes* could be assigned to the Centroderidae. Character states which support this argument include: 1) the presence of only 14 placids, of varying widths, as found in *Campyloderes* (16 placids in all other cyclorhagids); 2) two distinctive pores, possibly complexed sensory spots, near posteroventral margin of segment 3 as found in *Condyloderes*; and 3) the presence of dorsal spines on segments 4–11 (and 12 in male) in the adult.

Character states which support the assignment of *Dracoderes* to the family Echinoderidae include: 1) the absence of a midterminal spine in the adult; and 2) the absence of a lateral terminal accessory spine, as in males of all species of *Echinoderes* and both sexes in *E. coulli*.

Three pairs of penile spines, found in the male of *Dracoderes*, are common in the monotypic family Echinoderidae. Penile spines are unknown in the three genera comprising the Centroderidae. In one genus (*Centroderes*) and the monotypic family Zelinkaderidae, males possess a flexible subdorsal (and sometimes middorsal as well) spine with banding similar to that noted in one of two smaller pairs of penile spines in *Dracoderes*. Only two penile spines have been noted in the homalorhagids.

Although no other kinorhynch taxon is known to possess five 3-element and four single-element oral styles, 3-element oral styles are present in the cyclorhagid families Zelinkaderidae, Semnoderidae, and Cateriidae as well as in the homalorhagid family Neocentrophyidae. Single-element oral styles are present in the cyclorhagid genus *Condyloderes* and the homalorhagid family Pycnophyidae. Other cyclorhagid genera, including *Echinoderes*, have 2-element oral styles with the exception of the unique fused oral style complex in

Campyloderes.

The lateral, alternate displacement of dorsal

spines as well as the shape of the opening of the tergal cuticle through which each dorsal spine emerges are additional characters of *Dracoderes* unique within the phylum. Furthermore, no other taxon has the incised lateral sternal margins found in segments 8–10 of *Dracoderes*. Thus, a separate family has been erected to include the monotypic genus *Dracoderes*.

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